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Research Aid

China: Energy Balance Projections

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CHINA: ENERGY BALANCE PROJECTIONS

SUMMARY

1. China's sudden emergence as a major oil producer, with small but rapidly growing exports, has led to speculation that it may a few years hence become a major oil-exporter. Peking clearly intends to export increasing volumes of oil to help finance an ambitious program of capital imports, but it is by no means clear that China will become an important force in the world petroleum market. Domestic energy requirements place an important constraint on the level of energy exports. The key findings of this publication are:

a. China produced 428 million metric tons of coal equivalent in 1974, placing it fifth worldwide as a producer of energy – behind the United States, the USSR, Saudi Arabia, and Iran. As a consumer of energy, China ranks fourth behind the United States, the USSR, and Japan.

b. Energy production and consumption will continue to grow rapidly during 1975-80, along with a push for agricultural mechanization and stepped up industrial growth. Energy exports may run 40 to 50 million tons in coal equivalent terms (540,000 to 660,000 barrels per day of oil) in 1980; to export the 1 million barrels of oil per day that has been discussed with the Japanese, China would have to curtail economic growth.

c. The continued strong domestic demand for energy throughout 1981-85 will severely limit energy exports. By 1985, energy exports would be unlikely to exceed 100 million tons of coal equivalent (1.3 million barrels per day of oil), unless China sharply alters investment allocations favoring energy production, makes exports available at considerable cost to domestic economic growth, and/or agrees to joint ventures with foreign firms to exploit its energy resources. None of these actions seems likely at this time.

DISCUSSION

Introduction

2. Observers of the international oil scene, in their search for non-OPEC sources of oil, are becoming increasingly interested in China. Heartened by reports

of the rapid growth of China's oil industry and its "vast" oil resources, they view China as a potential source of sizable crude exports. Peking's actions have reinforced this view; it has indicated a willingness to expand oil exports to Japan to 1 million barrels per day (b/d) (50 million tons of oil annually) in 1980. Whether exports of this magnitude are feasible is not solely a question of continued rapid growth of oil output. Problems in the coal industry - evident since 1973 - complicate Peking's task of providing for domestic energy needs. If these problems continue, they conceivably could lead to restrictions on oil exports. Conversely, a decision to export large quantities of oil could, by restricting the growth of domestic energy supplies, hamper domestic economic growth. Both possibilities have important implications for China's economic development and foreign trade over the next several years.

3. This publication seeks to answer several questions: (1) How much energy does China produce and consume, and how rapidly have production and consumption of energy grown? (2) What are the major sources of energy? (3) Which sectors are the major energy consumers? (4) What are energy balances likely to be in 1980 and 1985? (5) Finally, how are domestic energy requirements likely to affect the availability of oil for export in 1980 and 1985?

Background

4. Temporary, local shortages of coal and electricity in China have been common occurrences. Until recently, however, there was little evidence that these shortages resulted from anything other than minor planning errors or transportation problems, and their impact on the economy, while not inconsequential, was slight. The coal shortages, which have prevailed since at least 1973 and which were particularly evident during 1974, appear to be more serious; rather than simply temporary and local in nature, they appear persistent and widespread.

5. In 1973 it was conceded that demand for anthracite and coking coal could no longer be met. Nearly half of China's small nitrogenous fertilizer plants were switched over to use lower quality, locally produced coal as supplies of coal from state-operated mines tightened. And yearend announcements of industrial achievements omitted any claims for coal despite its fundamental importance.

6. In 1974, it is clear that a worsening situation in coal production, coupled with transportation problems and disruptions resulting from the campaign to

criticize Lin Piao and Confucius, had a serious impact on coal supplies and on economic activity. Central Document 21, issued by Peking at midyear in an attempt to correct economic problems, complained that coal production for the first five months had fallen below target by 8.35 million tons. Its importance as a fuel for the railroads and the iron and steel industries compounded the problems faced by those sectors; in some locales coal shortages caused chemical fertilizer production to drop. Authorities in Shantung Province admitted that in order to provide needed coal supplies to industry and agriculture, the quantity of coal destined for household use had to be reduced. For the year, coal production grew by only 3.2%, compared with 5.9% in 1973 and 6.3% in 1972. The picture that emerges is one of a coal industry increasingly unable to meet the growing demand.

7. The situation in the petroleum industry is exactly the opposite. Since 1949, the average annual growth rate for crude oil output has exceeded 20%. Now, growing quantities are being exported; 1 million tons of crude oil went to Japan in 1973, followed by 4 million tons in 1974. An additional 1.5 million tons of crude and products may have gone to North Korea and North Vietnam last year. In 1975, Japanese importers have contracted for 7.8 million tons of crude oil. With additional exports of crude and products to North Vietnam, North Korea, Thailand, Laos, Hong Kong, and the Philippines, total Chinese oil exports should exceed 10 million tons - out of a total production of perhaps 80 million tons.

8. Oil exports are important to China's current fourth five-year plan and its upcoming fifth five-year plan (1976-80). Earnings from oil are needed to pay for imports of machinery and equipment, particularly whole plants (chemical fertilizer plants, synthetic fiber plants, and steel plants are among those already purchased). The importance of oil exports was demonstrated last year; when foreign markets for traditional export items softened, accelerated oil exports picked up some of the slack.

9. It is against this background that the adequacy of energy supplies and their interaction with oil exports are examined.

Energy Supply

Production

10. In its first 25 years, the People's Republic of China has become a major producer of energy. In coal production China ranks third in the world; in oil

production, thirteenth, just behind Indonesia; and in natural gas production, sixth.¹ Output series for coal, oil, natural gas, and hydroelectricity are shown in Appendix C; in Table 1 below these series have been converted to coal equivalent.²

Table 1

China: Production of Primary Energy¹

| | Total | Coal | Oil | Natural Gas ² | Hydro-electric |
|------|--|------|-----|--------------------------|----------------|
| | Million Metric Tons of Coal Equivalent | | | | |
| 1952 | 49 | 48 | 1 | N.A. | Negl. |
| 1957 | 97 | 93 | 2 | 1 | 1 |
| 1965 | 198 | 169 | 16 | 12 | 1 |
| 1970 | 306 | 233 | 43 | 28 | 2 |
| 1974 | 428 | 289 | 98 | 38 | 3 |
| | Percent | | | | |
| 1952 | 100 | 98 | 2 | N.A. | Negl. |
| 1957 | 100 | 96 | 2 | 1 | 1 |
| 1965 | 100 | 85 | 8 | 6 | 1 |
| 1970 | 100 | 76 | 14 | 9 | 1 |
| 1974 | 100 | 67 | 23 | 9 | 1 |

1. Data are for coal, crude oil, natural gas, and hydroelectric power expressed in terms of coal equivalents (calorific value of 7,000 kilocalories per kilogram) and exclude minor fuels such as peat and fuelwood. For conversion factors, see Appendix A.

2. Production and consumption of natural gas are discussed in Appendix B.

1. The comparisons are based on 1974 data.

2. For the factors used in conversion, see Appendix A. Energy as measured in this publication consists of coal, oil, natural gas, and hydroelectric power. Nuclear power -- nil or insignificant throughout the period under discussion -- is not considered. Coverage is limited to "commercial" energy sources -- so-called because of their dominance in domestic and foreign energy trade and their near-indispensability in modern industrial activity. Such noncommercial energy sources as fuelwood, organic waste, wind, and waterpower other than for electricity are excluded. The consequence of omitting noncommercial energy sources is to some extent minimized by the very low efficiency with which such fuels are traditionally used.

11. Production of primary energy has grown remarkably, reaching 428 million tons of coal equivalent in 1974 – a total exceeded only by the United States, the USSR, Saudi Arabia, and Iran. Only in recent years has average annual growth slipped below 9%; during 1971-74 growth averaged 8.7% annually. This compares with a 9.1% average rate for 1966-70, 9.3% during 1958-65, and 14.9% in 1953-57. A look at the changing composition of energy production helps pinpoint the reason for the slight secular decline in output growth in the past decade.

12. In 1957, coal accounted for 96% of the primary energy produced; by 1974, its share had fallen to 67%. This decline is explained by the more rapid growth of oil and natural gas production and by a slowing in the growth of coal output. During 1958-74, coal output in standard fuel equivalent grew by 6.9% yearly; however, growth fell from an average of 7.7% for 1958-65 to 6.5% in 1966-70 and to 5.6% in 1971-74. In 1974, coal output grew by only 2.9%. Peking's efforts to expand coal production through the development of small mines, rather than large ones, have contributed to this slackening in growth. In 1957, the share of coal output produced at small mines was only 6%; this grew to 15% in 1965, 25% in 1970, and 28% in 1974. The success of this effort, however, has been limited by the fact that coal from the small mines generally is of lower calorific content and contains larger quantities of rock and dirt. Taking these factors into account and discounting coal produced at small mines reduces the energy content of the coal produced and the growth of coal-source energy.³ For example, during 1966-70 – when small mine production grew from 15% to 25% of total output – national production of raw coal grew by 7.1% annually; in terms of energy content, however, growth was only 6.5% annually.

Supply

13. Adjustments for energy exports and imports – to derive domestic energy availability – alter the above picture only slightly.⁴

14. Energy supplies grew at an average annual rate of 8.9% in 1958-74, with rates ranging from a high of 9.0% in 1958-65 to a low of 8.4% in 1971-74. The declining growth of coal output was to a large extent offset by the continued

3. For details, see Appendix A.

4. China exported about 1 million tons of coal in 1957 and perhaps some 3 million tons in 1974 – that is, less than 1% of total output, a relationship which probably has been fairly constant since 1957. The only other energy exports were those of crude oil and petroleum products. Petroleum exports were insignificant prior to 1973, when some 2 million tons of crude oil were exported; in 1974, approximately 6 million tons of crude oil were exported – 9% of production.

Table 2

China: Supply of Primary Energy

| | Total | Ccal | Oil | Natural Gas | Hydro- electricity |
|------|---|------|-----|----------------|-----------------------|
| | Million Metric Tons of Coal Equivalent | | | | |
| 1952 | 50 | 48 | 2 | N.A. | Negl. |
| 1957 | 100 | 93 | 5 | 1 | 1 |
| 1965 | 198 | 168 | 17 | 12 | 1 |
| 1970 | 304 | 231 | 43 | 28 | 2 |
| 1974 | 419 | 287 | 91 | 38 | 3 |
| | Percent | | | | |
| 1952 | 100 | 96 | 4 | N.A. | Negl. |
| 1957 | 100 | 93 | 5 | 1 | 1 |
| 1965 | 100 | 85 | 9 | 6 | Negl. |
| 1970 | 100 | 76 | 14 | 9 | 1 |
| 1974 | 100 | 68 | 22 | 9 | 1 |

rapid growth in oil. This was most apparent during 1971-74, when oil's share of the energy supply grew from 14% in 1970 to 22% in 1974, as coal's share dipped from 76% to 68% (see Table 2). Even so the average annual rate of growth of overall energy supplies fell by 0.5% during that period.

15. One can see the substitution of oil for coal more clearly from their respective contributions to increments in total energy supplies. During 1958-65, total energy supplies grew by 99 million tons – coal provided 76%, while oil provided 12%. During 1971-74, energy supplies grew by 116 million tons – coal provided 48%, while oil provided 41%.⁵

5. Of the increment in coal supplies in 1971-74, 34% came from small mines, compared with 19% in 1958-65 and 42% in 1966-70.

16. The substitution of oil for coal has not been without its costs. Converting industrial facilities from coal-burning to oil-burning, particularly over such a short period, has required investment that could have been used elsewhere.⁶ Presumably having made the decision during the early 1960s to expand oil production, Peking paid this premium with the understanding that it was the least costly of the alternatives available. An examination of energy consumption by consuming sector and by source shows where this conversion has taken place.

Energy Consumption

17. Primary energy consumption grew from 97 million tons of coal equivalent in 1957 to 380 million tons in 1974 – an 8.4% annual rate of increase (see Table 3). By far the most rapidly growing consumer of energy has been agriculture,

Table 3

China: Consumption of Primary Energy, by Sector

| | Total | Industry and Construction | Agri- culture | Transpor- tation | Residential/ Commercial |
|------|---|---------------------------------|------------------|---------------------|----------------------------|
| | Million Metric Tons of Coal Equivalent | | | | |
| 1952 | 42 | 11 | Negl. | 5 | 26 |
| 1957 | 97 | 36 | 1 | 9 | 51 |
| 1965 | 185 | 89 | 6 | 14 | 76 |
| 1970 | 278 | 159 | 12 | 16 | 91 |
| 1974 | 380 | 235 | 24 | 19 | 102 |
| | Percent | | | | |
| 1952 | 100 | 26 | Negl. | 12 | 62 |
| 1957 | 100 | 37 | 1 | 9 | 53 |
| 1965 | 100 | 48 | 3 | 8 | 41 |
| 1970 | 100 | 57 | 4 | 6 | 33 |
| 1974 | 100 | 62 | 6 | 5 | 27 |

6. Obviously some newly added capacity was designed to be oil-burning. However, the magnitude and rapidity of the conversion from coal to oil suggest that the conversion of existing facilities accounts for a large portion of total conversion.

where energy use grew at an average annual rate of 26% in 1958-74⁷; consumption in industry grew 11.6% per year over the same period. The growth rates for energy consumption by the transportation and residential/commercial sectors were only 4.7% and 4.2%, respectively.

18. As a result of differential growth, the share of energy consumed by agriculture grew from 0.5% in 1957 to 6% in 1974, and industry's share grew from 37% to 62%. Transportation in 1974 used only 5% of the energy consumed, versus 9% in 1957; for residential/commercial use the share declined from 53% in 1957 to 27% in 1974.

19. Substitution of oil for coal has occurred most heavily in industry. In industry, coal accounted for 93% of the fuel consumed in 1957 (see Table 8 in Appendix D) and 68% in 1974, while oil's share grew from 5% to 22%. By contrast, 90% of the fuel consumed in agriculture in 1957 was petroleum, with coal providing only 10%; by 1974, coal accounted for 17%, with oil supplying 82%. Most of this coal was consumed indirectly as electricity. Of the increment in energy consumption since 1957 - 283 million tons - industry and agriculture consumed 78%.

20. The remaining two sectors also derive larger shares of their energy needs from oil. While highway and inland waterway transportation together consume more than 80% of the oil used in the transportation sector, dieselization of the railroad system beginning in the late 1960s added to petroleum requirements for the transport sector. As of 1974, however, railroads used less than 1% of total oil supplies and less than 20% of the oil used in transportation. Little petroleum is used by the residential/commercial sector. Kerosine was once a major fuel source for lighting. It no longer is rationed as it was until the late 1960s; households and commercial establishments now rely on electricity, only part of which is produced in oil-burning powerplants.

21. Behind rapidly growing energy use in industry and agriculture is the push for the development of heavy industry and agricultural mechanization. Iron and steel, chemical fertilizer, petrochemicals, and electric power generation are all heavy consumers of primary energy. In agriculture, the increased use of diesel and electric motors for a variety of farm tasks - for irrigation and pumping in particular and for the initial processing of agricultural commodities - has greatly increased consumption of oil and electricity. Much of the electricity is provided by large

7. From 0.5 million tons to 24 million tons.

numbers of small hydroelectric stations which have been erected throughout the rural areas during the past 10 years.

22. Finally, the importance assigned in the late 1960s to rural small-scale industry has contributed to increased energy requirements. Small-scale plants – producing iron and steel, cement, fertilizer, electric power, and a variety of simple machines for agriculture – are less efficient users of primary energy than are larger plants, which benefit from economies of scale, more modern technology, and more efficient management. Consequently, as output from small-scale plants has grown in importance (see Table 4), incremental energy requirements per unit of output have risen.

Table 4

China: Output by Small-Scale Plants

| | Percent of Total | | | |
|-------------------------------|------------------|------|------|------|
| | 1957 | 1965 | 1970 | 1974 |
| Hydroelectricity ¹ | Negl. | 1 | 2 | 5 |
| Nitrogen fertilizer | Negl. | 3 | 43 | 50 |
| Cement | N.A. | 26 | 30 | 52 |
| Crude steel ² | N.A. | 4 | 10 | 13 |

1. Percent of total hydroelectric capacity.

2. Percent produced in medium-size and small plants.

Energy and Economic Growth

23. The relationship between energy consumption and economic growth is summarized as an energy-GNP elasticity coefficient – a ratio which indicates the percentage change in energy consumption for a 1% change in GNP. Energy-GNP elasticities rarely are lower than 1 or higher than 2; however, they vary widely from country to country and over time, as shown in Table 5.

24. In China for the 1958-74 period, the energy-GNP elasticity coefficient was 1.62 – that is, for a 1% increase in GNP, energy consumption grew by 1.62% on the average. This relationship has changed considerably over the years. It was 2.57 during 1953-57; 1.87 during 1958-65; 1.42 during 1966-70; and 1.42 during 1971-74. The apparent leveling off of the elasticity coefficient since 1965 – at what is a moderate level when compared with other countries – reveals a certain maturity of energy use, despite the very low per capita energy consumption in China.

Table 5

Energy-GNP Elasticity Coefficients for Selected Countries¹
1950-65

| Per Capita GNP Range in 1965 | Country ² | Energy-GNP Elasticity Coefficient |
|------------------------------------|----------------------|---|
| Over \$1,800 | United States | 0.81 |
| | Canada | 1.13 |
| | Sweden | 1.59 |
| | Denmark | 1.38 |
| | Switzerland | 1.64 |
| | West Germany | 0.76 |
| | France | 1.00 |
| | Norway | 1.24 |
| | United Kingdom | 0.62 |
| | Belgium-Luxembourg | 0.94 |
| | Australia | 1.21 |
| | Netherlands | 1.17 |
| \$1,000 to \$1,800 | East Germany | 0.88 |
| | Czechoslovakia | 1.47 |
| | Austria | 0.83 |
| | USSR | 1.25 |
| | Israel | 1.13 |
| | Italy | 2.16 |
| | Japan | 1.00 |
| | Hungary | 1.62 |
| | Puerto Rico | 1.93 |
| | | |
| \$700 to \$1,000 | Venezuela | 1.61 |
| | Bulgaria | 2.14 |
| | Romania | 1.60 |
| | Greece | 1.41 |
| | Yugoslavia | 1.18 |
| | Argentina | 1.81 |
| Under \$700 | Spain | 0.84 |
| | South Africa | 1.09 |
| | Chile | 1.53 |
| | Mexico | 1.13 |
| | Costa Rica | 1.25 |
| | China | 2.18 ³ |

1. With the exception of the coefficient for China, the data in this table were taken from Joel Darmstadter, *et al.*, *Energy in the World Economy*, Baltimore, The Johns Hopkins University Press, 1971, p. 37.

2. Countries are listed according to their 1965 per capita GNP ranking.

3. Pertains to 1953-65.

25. The elasticity coefficients calculated here are useful in projecting future energy demand, which is discussed in the following section.

Prospects

26. This section addresses two questions: (1) will energy supplies be sufficient for the economic growth envisioned by China's planners for 1975-80; and (2) what impact will energy balances have on potential oil exports? To answer these questions requires projecting, and comparing, the supply of and demand for energy in 1975-80.

Energy Supply Projections

27. Supplies of coal, oil, natural gas, and hydroelectricity have been projected to 1980. Three projections have been made: high, medium, and low (see Table 6).⁸

Table 6

China: Projections of Energy Supply and Demand 1980

| Projection | Supply ^{1,2} | | Demand ² | |
|------------|---|---------------------------------------|---|---------------------------------------|
| | Million Metric Tons of Coal Equivalent | Annual Growth 1975-80 (Percent) | Million Metric Tons of Coal Equivalent | Annual Growth 1975-80 (Percent) |
| High | 777 | 12.7 | 725 | 11.4 |
| Medium | 682 | 10.3 | 670 | 9.9 |
| Low | 602 | 8.0 | 616 | 8.4 |

1. Production minus handling losses and additions to inventory. The projections assume a slight decline in the ratio of energy inventory to final output.

2. For a discussion of the derivation of these projections, see Appendix D.

In the high growth case, the supply of energy⁹ increases by 12.7% annually to reach 777 million tons of coal equivalent in 1980. In the medium growth case,

8. For details on methodology and data, see Appendix C.

9. In the following discussion, supply is defined as production minus handling losses and additions to inventory. The projections assume a slight decline in the energy inventory-final output ratio. The definition of supply used here differs from that used in the earlier section headed "Supply." There, supply is defined as production minus net exports.

the supply of energy grow by 10.3% per year and reaches 682 million tons in 1980. Finally, under conditions of low energy growth, the supply grows by 8.0% annually and reaches 602 million tons in 1980. Any of these rates appear feasible when compared with the growth rates of energy production¹⁰ in past periods. The growth of the high projection (12.7%) is below the 14.9% for 1953-57, but it exceeds the rate of growth for any of the three periods since 1957; that of the low projection (8.0%) falls below the 8.7% in 1971-74. Our medium projection (10.3%) grows slightly more rapidly than did energy production in 1958-65.¹¹

28. All three projections assume further substitution of oil for coal, as shown in the following tabulation:

| | Percent of Total Energy Production | | | |
|--------|------------------------------------|-----|-----|---------------|
| | Coal | Oil | Gas | Hydroelectric |
| 1974 | 67 | 23 | 9 | 1 |
| 1980 | | | | |
| High | 51 | 35 | 13 | 1 |
| Medium | 57 | 30 | 12 | 1 |
| Low | 63 | 26 | 10 | 1 |

29. Regardless of the projection used, energy production in 1980 will depend heavily on the performance of the coal and petroleum industries. Of the increment in energy output between 1974 and 1980, coal and oil will account for 82% to 87%. The question that arises is: How likely are these sectors to achieve the growth envisioned? The medium projection is used for this discussion.

30. The difficulties encountered by the coal industry in 1973-74 – difficulties which have continued in 1975 – have been detailed above. Labor problems are responsible for part of the coal shortages in 1974 and 1975, but a longer standing problem is that of inadequate equipment. China possesses huge coal resources but lacks the modern equipment to exploit them fully. In recent years, Peking has begun to move away from a policy that stressed labor-intensive methods of increasing coal output and is importing some new capital equipment. The 6.5% annual growth for coal used in the medium supply projection¹² assumes that the

10. Because we are interested in the amount of energy that *could* be supplied, and regard exports as a residual, the comparison to growth rates of energy output is the proper one.

11. We assume a decline in handling losses and in the ratio of energy inventory to final output. Without this assumption, the growth rate for the medium projection would be 10%; those for the high and low projections would be 12.4% and 7.7%, respectively.

12. For past growth rates of coal output, see the discussion of the supply projections contained in Appendix C.

coal industry will continue to experience troubles in the early years of the fifth five-year plan but will achieve higher growth in the latter years of the period as increasing amounts of modern equipment are installed in old and new mines.

31. In contrast to the coal industry, the petroleum industry has had no trouble maintaining a growth rate in excess of 20% annually. It is doubtful, however, that an annual rate of growth of 20% or higher can be sustained for the period 1975-80; an average annual growth rate of 15% seems more realistic. To maintain high rates of investment in agriculture and in certain branches of industry (including the petroleum industry), Peking during the past several years has been forced to neglect investment in other sectors (e.g., coal, steel, and transportation). Now, planning authorities are faced with the necessity of stepping up investment in the neglected sectors – while maintaining (or even increasing) investment in agriculture – and the petroleum industry can no longer be assured the sharply rising rates of investment needed to maintain 20% growth. Other factors which threaten to reduce the rate of growth of crude output also come into play: increments to crude oil output can be expected to become more costly as Peking uses up its cheaper sources of oil, and the volume of new oil production required to offset depletion of existing wells will grow. Both phenomena can be expected to reduce the effectiveness of new investment and, on top of constant or only slightly growing investment in the petroleum industry, lead to a declining rate of output growth. Judging from recent 8-month claims (25.5% increase over 1974), crude oil production this year will grow by about 15 million tons above the level of 1974. Annual increases of this absolute amount – 15 million tons – seem most likely under the constraints noted above. If so, the growth rate for the period 1975-80 would be about 15%.

Energy Demand Projections

32. Demand for energy is projected, using two methods (see Table 6): (1) assuming high, medium, and low rates of GNP growth, the energy-GNP elasticity coefficient is used to calculate a required growth rate for energy supply; and (2) high, medium, and low projections are made for each of the four sectors of the economy. For each projection, demand by sector is summed to obtain a projection for total energy demand.

33. GNP grew by 6% annually during 1966-70; growth during 1958-65 and 1971-74 was 4.5% and 5.6%, respectively. Peking, faced with problems the solution of which is made easier by more rapid economic growth, would likely be dissatisfied with GNP growth much lower than 6%. If the 6% rate were adopted as the target

for 1975-80, and assuming an energy-GNP elasticity of 1.42 (as calculated for 1966-74), energy supplies would need to grow at an 8.5% annual rate during 1975-80.¹³ Higher and lower rates of GNP growth would require higher and lower rates of growth for energy supply, as the tabulation below indicates:

The problem, of course, is specifying the rate of growth which Peking is likely to shoot for. Looking at the economy sector by sector, observing past sectoral growth rates, and projecting sectoral energy demand on the basis of continued heavy support to agriculture and additional support to those sectors encountering difficulties helps us to specify more likely growth rates, both for energy demand and for GNP growth targets.

| GNP Growth | Percent |
|---------------|------------------------------|
| | Required Energy Growth |
| 4 | 5.7 |
| 6 | 8.5 |
| 8 | 11.4 |

34. Sectoral projections show energy demand growing by between 8.4% and 11.4% annually and reaching between 616 and 725 million tons of coal equivalent in 1980 (see Table 6).¹⁴ These projections imply that GNP growth of 6% per year would represent the lower limit of the range of growth rates preferred by Peking. Implicit in the 9.9% and 11.4% annual growth of energy demand shown for the medium and high projections are average annual GNP growth rates of 7% and 8% - rates which exceed the highest growth obtained in any of the three periods used in this publication (6% in 1966-70).

35. Before projections of energy demand are compared with the projections for energy supplies, a brief discussion of Chinese thoughts regarding future energy exports is in order.

36. Peking has indicated a desire to expand oil exports to Japan to a rate of 50 million tons annually by 1980, and future coal exports to Japan have been discussed. Exports of 50 million tons of crude oil would mean that the domestic energy supply in 1980 would be 75 million tons (standard fuel equivalent) less than calculated above.¹⁵ The consequent reduced domestic energy supplies for 1980 and the lower rates of supply growth for 1975-80 would be as shown in Table 7. Annual exports of 75 million tons of coal equivalent by 1980 - between 10% and 12% of projected energy supplies - would reduce the average annual rate of growth of the energy supply by 1.9 to 2.4 percentage points. The significance of energy exports of this magnitude becomes obvious when projected supplies, gross and net of exports, are compared with projections for demand.

13. To the extent that supplies in 1974 were inadequate, the rate would need to be slightly higher than 8.5%.

14. Details on methodology can be found in Appendix D.

15. One ton of crude oil is the energy equivalent of 1.5 tons of coal.

Table 7

China: Impact of Exports on Energy Supply
1980

| Projection | No Exports | | Exports of 75 Million Metric Tons | |
|------------|---|---------------------------------------|---|---------------------------------------|
| | Supply (Million Metric Tons of Coal Equivalent) | Annual Growth 1975-80 (Percent) | Supply (Million Metric Tons of Coal Equivalent) | Annual Growth 1975-80 (Percent) |
| High | 777 | 12.7 | 702 | 10.8 |
| Medium | 682 | 10.3 | 607 | 8.1 |
| Low | 602 | 8.0 | 527 | 5.6 |

Energy Balances in 1980 and 1985

37. Table 6 shows projections of the demand for and supply of energy in 1980. The tabulation below of the exportable surplus in 1980, which summarizes Table 6, serves two purposes: (1) a positive number indicates that supply exceeds demand and hence the existence of an exportable surplus; and (2) a negative number indicates that demand exceeds supply and that the particular supply-demand combination is inconsistent.

| Demand | Supply ¹ | | |
|--------|---------------------------------|--------|------|
| | High | Medium | Low |
| | Million Tons of Coal Equivalent | | |
| High | 52 | -43 | -123 |
| Medium | 107 | 12 | -68 |
| Low | 161 | 66 | -14 |

1. Projected supply minus projected demand.

38. A comparison of the numbers in the above tabulation shows that, with high supply growth, China would have a substantial exportable surplus whatever the demand projection – a surplus ranging from 52 million tons to 161 million tons. But if high supply growth is ruled out, as the most unlikely of the three

projections, export prospects are much more moderate. Medium supply growth will accommodate both medium and low demand growth and leave an exportable surplus: with medium growth in demand the surplus would be 12 million tons; with low growth in demand the surplus would be 66 million tons.

39. Low growth of demand (implicit GNP growth of 5.9% annually) would imply continued or prolonged economic problems such as have bothered Peking for the past few years. GNP growth during 1971-74, a period marked by growing imbalances and shortages, averaged 5.6%.¹⁶ Medium growth of demand (implicit 7% GNP growth), on the other hand, implies a rate of growth that may be slightly above the rate Peking can realistically hope to attain. A rate of 6% to 6.5% GNP growth, implying low to medium growth in demand and a degree of success in resolving current imbalances and shortages, may be reasonable. Under these circumstances -- medium growth of supply and low to medium growth of demand -- China's energy supply will grow about 10% annually, GNP growth will average between 6% and 6.5%, and between 12 and 66 million tons of standard coal equivalent will be available for export.

40. While the available data do not permit a reliable assessment of trends in efficiency of energy use, it seems likely that any improvement in efficiency will be more than offset by the rapid expansion of industries which consume large amounts of energy per unit final output. The rapid growth of these industries (the chemical fertilizer and petrochemical industries, for example) might result in a slight increase in the energy-GNP elasticity coefficient used here (1.42). An increase in the coefficient, coupled with GNP growth of between 6% and 6.5%, could mean that the exportable surplus would not exceed 40 to 50 million tons of coal equivalent in 1980¹⁷ -- the equivalent of 27 to 33 million tons (540,000 to 660,000 b/d) of oil.

41. How do we reconcile these conclusions -- that the exportable surplus in 1980 could be no more than 40 to 50 million tons of coal equivalent -- with the indicated Chinese willingness to export 75 million tons of coal equivalent (50 million tons of oil equivalent) to Japan in 1980? Any numbers mentioned publicly, before actual negotiations, should be considered no more than order of magnitude figures. Aside from this, there are reasons why the Chinese might want to exaggerate their energy export capacity in 1980. (1) A desire to counter Soviet attempts to

16. From an estimated \$179 billion in 1970 to \$223 billion in 1974.

17. With (1) an average annual GNP growth of 6.3% in 1975-80; (2) a slight rise in the energy-GNP elasticity coefficient from 1.42 to 1.45; and (3) medium supply growth; the exportable surplus would decline to approximately 45 million tons in 1980.

involve Japan in the development of Siberian resources; China's offer to the Japanese was first made at a time when the Soviets were courting the Japanese very intensely, holding out the vast benefits that would accrue to Japan as a result of its participation in the development of Siberian resources. (2) A domestic political situation encouraging inflation of the potential political and economic benefits of policies advocated; sharply rising oil exports were essential to large purchases of foreign capital goods and thus to the international goodwill which would be generated by an expanding foreign trade. Either of these reasons would provide China's leadership sufficient rationale for giving a rosy picture of oil export capabilities in 1980, a year which after all was more than five years distant. These reasons existed in addition to the normal tendency of central planners to overestimate the future ability of the economy to produce. Collectively, these elements probably are sufficient reason to argue that any announced export capacity for 1980 is likely to be somewhat exaggerated.

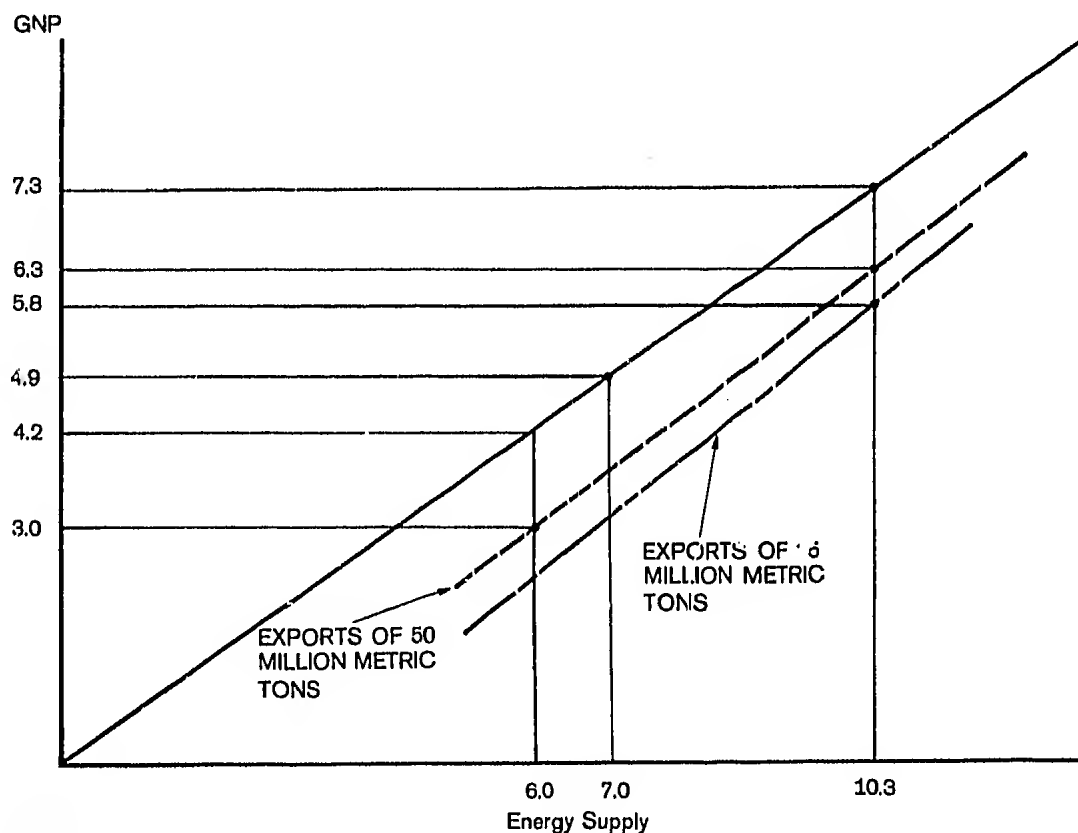
42. In the discussion above, energy exports have been treated as a residual, determined by domestic energy production and the domestic demand for energy. However, Peking probably sees some minimal quantity of energy exports as absolutely essential to future import plans. Thus, it may be willing to temporarily sacrifice some growth in certain sectors in order to accelerate future growth in other sectors (by importing capital equipment and plant).¹⁸ The chart illustrates the relationship between energy consumption and GNP growth and shows the trade-off between GNP growth and energy exports, an important element in the calculus of planning energy exports. As shown in the graph, a 7% rate of growth in the energy supply would permit GNP to grow at a rate of 4.9%;¹⁹ a 6% growth rate for the energy supply would restrain GNP growth to 4.2%. The chart also shows the impact on GNP growth of exporting 50 million tons and 75 million tons, assuming medium growth in the supply of energy (10.3%). With no exports, a 10.3% growth rate in the energy supply permits a 7.3% rate of growth in GNP. Exports totaling 50 million tons reduce GNP growth to 6.3%; exports of 75 million tons reduce GNP growth to 5.8%. At lower rates of growth of energy supply, the impact of a given level of exports is even greater.

43. The data presented above suggest that China may have to curtail economic growth if more than 50 million tons of coal equivalent are to be exported in

18. Energy exports do not necessarily mean that GNP growth is being sacrificed. A situation could exist whereby energy is not the effective constraint to growth (it could be steel, for example), in which case no growth would be forgone by exporting some given amount of energy.

19. Note that the GNP rate shown is a maximum rate, under the implicit assumption that energy growth alone is the effective constraint on GNP growth.

China: Annual Percentage Growth of Energy Supply and GNP



567815 10-75

1980. An alternative solution for Peking is to accelerate investment and output in the energy producing industries, something that could be done most easily in the petroleum and natural gas industries.²⁰ To achieve an exportable surplus of 75 million tons of coal equivalent in 1980, assuming medium growth of demand and growth rates of 6.5% and 8% in coal and hydroelectric production, would require average annual growth of at least 18% for oil and gas production during 1975-80 -- compared with the 15% rate used in the medium projection.²¹ Such a growth rate would appear to require a sharp increase in the rate of investment in these industries, to a level that may be beyond Peking's current capacity.

20. Describing this as an alternative solution implies an increase in overall investment, not simply in the investment made in the petroleum and gas industries. Otherwise, with investment held constant (that is, shifted among sectors), the two "alternatives" become two possible outcomes of a single decision, and the decision to step up oil and gas production, for example, implies a curtailment of growth in other sectors.

21. Actually the 18% growth rate would produce an export surplus of only 60 million tons; we assume that Peking could make an additional 15 million tons available through increased efficiency and by shaving growth.

44. Putting aside the question of whether or not China can accelerate oil and gas production while at the same time tending to other problems, it is interesting to examine the outcome in 1985 of a continuation of 18% average annual growth in oil and gas production. By 1985, an 18% rate of growth for oil and gas could lead to an exportable surplus of just under 200 million tons of standard coal equivalent, or the equivalent of 2.6 million b/d of oil (131 million tons annually).²² Thus under what appear to be extremely favorable assumptions, China would be in a position to export in 1985 only one-tenth of the oil exported by OPEC in 1974.²³ This is hardly in keeping with the image of a country whose potential oil resources have been compared with those of the entire Middle East. In fact, it underscores just how inapt these comparisons really are.

45. China, for all its success in expanding energy production, remains a country with a population of more than 900 million people, some 80% of whom are employed in agriculture. Unlike other major LDC oil producers, China's domestic demand for energy is large and growing rapidly. Peking's commitment to modernization and expansion in industry, agriculture, and transportation means that only a limited portion of energy output will become available for export. How much energy, then, can Peking realistically be expected to export in 1985? Just how optimistic is the 2.6 million b/d of oil mentioned above?

46. To begin with, it is highly unlikely that China could achieve a rate of growth of 18% annually in oil and gas production even for the 1975-80 period. It is simply that the investment requirements are so large. A 15% rate of growth is more realistic, but it too may be somewhat optimistic. Beyond 1980, with oil output above 200 million tons annually (4 million b/d), average annual growth of 10% would be a remarkable achievement.²⁴ On the demand side, beyond 1980 there is a good chance that Peking will attempt to accelerate industrial growth. This would raise domestic energy consumption and tend to reduce any exportable energy surplus. In fact, one can find what appear to be reasonable sets of numbers for supply and demand growth which imply that the exportable surplus in 1985 may well be no more than 100 million tons (1.3 million b/d of oil).

22. This assumes that demand continues to grow at the rates used in the medium projection for 1975-80 and that coal and hydroelectric output grow at 6.5% (on top of 6.5% in 1975-80) and 6% (on top of 8% in 1975-80), respectively.

23. OPEC exported 29.2 million b/d of oil in 1974. This may fall to 26.2 million b/d of oil in 1980.

24. An examination of oil production by geographic area (North America, Latin America, the Middle East, and Africa) reveals that, after production reached 4 million b/d, growth rates rarely reached 10%. Only in the case of the Middle East did it go as high as 10%, and there it was only 10.2%, as output grew from 3.2 million b/d in 1955 to 5.2 million b/d in 1960. Between 1960 and 1965, the rate fell to just under 10%. The record of output growth in individual countries also shows growth rates that rarely exceed 10% a year, once the 4 million b/d rate has been reached. Rates for the United States (3.8%, 1940-50), the USSR (6.5%, 1965-73), and Venezuela (1.3%, 1965-70) bear this out. On the other hand, in Iran and Saudi Arabia, growth exceeded 20% annually (21% and 29%, respectively, for 1970-73). Clearly, Iran and Saudi Arabia are special cases, and we should refrain from comparing China's oil industry with either of those countries'. See *International Petroleum Encyclopedia*, Tulsa, The Petroleum Publishing Co., 1974, pp. 306-308.

APPENDIX A

CONVERSION FACTORS

Coal

Raw coal has been converted into coal equivalent at the rate of 0.8 ton of energy per ton of raw coal produced at large mines and 0.6 ton of energy per ton of raw coal produced at small mines. Thus the overall conversion rate is an average which varies with the large mine-small mine output mix. China's coal would warrant higher conversion rates - perhaps 0.90-0.95 for coal produced at large mines and perhaps 0.8 for that produced at small mines - were it not for the fact that coal output is reported at the mine head - that is, before dirt and rocks are removed and before the coal is washed.

The average rates used here are in line with those used by Wu Yuan-li for the 1950s. Implicit is the assumption that, had the 1957 output mix from large and small mines prevailed, the average conversion rate would have been 0.79 throughout the post-1957 period - that is, that progress in cleaning, etc., would have raised the conversion factor by more than 10% above that of the 1950s. Instead, the rising share of output from small mines, where impurities are greater and the average calorific content lower, has resulted in conversion factors of 0.77 for 1965; 0.75 for 1970; and 0.744 for 1974. The conversion rate used for 1952 and 1957 - 0.715 - was taken from Wu Yuan-li, *Economic Development and the Use of Energy Resources in Communist China*, New York, Frederick A. Praeger, 1963, p. 107.

Oil

Crude oil has been converted into coal equivalent at the rate of 1.5 tons of energy per ton of crude oil. This factor, rather than the usual 1.3, is used because the Chinese consume some of their crude oil directly in powerplants and also because the 1.5 conversion factor more accurately reflects the energy content of crude oil. The 1.3 rate assumes that all crude oil is consumed indirectly as petroleum products, with part of its energy content lost in refinery processing (see Joel Darmstadter, *Energy in the World Economy*, Baltimore, The Johns Hopkins Press, 1971. p. 829).

Natural Gas

Natural gas has been converted into coal equivalent at the rate of 1.332 tons of energy per 1,000 cubic meters.

Hydroelectricity

Hydroelectricity has been converted into coal equivalent at the rate of 0.125 tons of energy per 1,000 kilowatt hours.

APPENDIX B

SUPPLY OF NATURAL GAS

In estimating the supply of natural gas, one immediately encounters a problem: the official claims for natural gas production in Szechwan Province – which accounts for some 90% of total production – imply implausibly high levels of energy consumption in that province. Since there are no pipelines extending to other provinces, transportation and handling losses and/or a peculiar definition of production clearly must account for the large discrepancy between production and any plausible estimate of consumption.

Since natural gas production doubtlessly is measured at the wellhead, the situation is akin to that of electric power where, after subtracting electricity used by power stations and transmission losses, electricity actually reaching the consumer is diminished by 15%. Because natural gas is superabundant in Szechwan (and thus probably priced very low), efforts to reduce handling losses and wasteful use have probably received only minor attention.

The problem has been resolved by making estimates of the economically significant quantity – the natural gas reaching final consumers. This has been done in the following manner: (1) It is assumed, in the absence of evidence to the contrary, that the per capita energy supply in Szechwan is the same as that outside Szechwan. (2) The per capita energy supply was then calculated for Szechwan (excluding energy from natural gas) and for the rest of the country (where energy from natural gas is a very small portion of total energy supply). The resulting difference, when multiplied by the population of Szechwan, is a measure of energy from natural gas and, when converted, of raw natural gas supply in Szechwan.

Objections to this method can be made on several grounds. However, in the absence of further evidence, it has the virtue of being straightforward and involving only one assumption which, although open to challenge, is within reason. The data used and the calculations made are as follows:

**Energy Production
in Szechwan,
1973**

| | Actual | Coal Equivalent¹ | Per Capita Energy Supply² |
|---------------|------------------|--|---|
| Total | | 11.2 | 0.116 tons |
| Coal | 14 ¹ | 10.4 | |
| Oil | 0.2 ¹ | 0.3 | |
| Hydroelectric | 4 ³ | 0.5 | |

1. Million tons. Raw coal is converted into coal equivalent at the rate of 0.746 ton of coal equivalent per ton of raw coal.

2. Szechwan's population is estimated at 96.7 million. Energy exports are assumed to be insignificant.

3. Billion kilowatt hours.

**Energy Production
Outside Szechwan,
1973**

| | Actual | Coal Equivalent¹ | Per Capita Energy Supply² |
|-------------------|------------------|--|---|
| Total | | 354.7 | 0.442 tons |
| Coal ³ | 360 ¹ | 269 | |
| Oil ⁴ | 52 ¹ | 78 | |
| Gas | 4 ⁵ | 5.3 | |
| Hydroelectric | 19 ⁶ | 2.4 | |

1. Million tons.

2. Population outside Szechwan is estimated at 802 million.

3. Minus 3 million tons of exports. The conversion rate used is 0.746 ton of coal equivalent per ton of raw coal.

4. Minus 2 million tons of exports and some production from coal.

5. Billion cubic meters.

6. Billion kilowatt hours.

The difference between the two per capita energy supply figures is 0.326 ton, which when multiplied by the population of Szechwan gives a figure of 31.5 million tons of coal equivalent, or 23.6 billion cubic meters of natural gas.

The supply of natural gas calculated in this manner is approximately half of natural gas production in Szechwan. One would prefer to go through this same procedure for each year to establish estimates for natural gas supply; however, energy data for Szechwan are not readily available. Consequently, natural gas supply

in Szechwan has been taken as one-half of the estimate of natural gas production. Outside Szechwan, it is assumed that waste is negligible (since natural gas is much more expensive elsewhere). Total natural gas output is derived by adding supply in Szechwan to production outside Szechwan.

APPENDIX C

PROJECTIONS OF ENERGY SUPPLY IN 1980

Past rates of growth in energy production are the basic desiderata in projecting energy supplies in 1980. The tabulation below, showing the annual growth rates of energy production by source and the time period, is presented for reference.

| | Percent ¹ | | | | |
|---------|----------------------|-----|-------------|-------------------|-------|
| | Coal | Oil | Natural Gas | Hydro-electricity | Total |
| 1958-65 | 7.7 | 28 | 36 | 8.4 | 9.3 |
| 1966-70 | 6.5 | 21 | 18 | 9.2 | 9.1 |
| 1971-74 | 5.6 | 23 | 8.6 | 14 | 8.7 |
| 1958-74 | 6.9 | 25 | 26 | 10.1 | 9.1 |

1. The rates are for output measured in coal equivalent. Rates higher than 11% have been rounded.

Three projections were made: high, medium, and low. Under each, a growth rate for 1975-80 was selected for each energy source (coal, oil, natural gas, and hydroelectricity), output of each source was projected to 1980, and the individual projections were then summed to obtain total energy supply in 1980. For the high projection we have attempted to select growth rates that reflect a realistic maximal output performance in 1975-80, keeping in mind current economic problems and the capital shortage that probably will constrain growth over the next several years. The high rates thus do not necessarily equal or exceed the highest growth rates obtained in the past. Growth rates for the medium and low projections are chosen on the basis of the growth rate selected for the high projection and variations in past growth rates. For example, in the case of coal (where a 7% growth rate was selected for the high projection) growth has ranged between 5.6% and 7.7%; hence the difference between the high and the low rates should not be too large. We therefore selected a 6.5% rate for the medium projection and a 6% rate for the low projection. With the other energy sources, where variations in growth rates have been larger, the difference between the rates selected for the high and low projections is larger. The growth rates used in the projections are shown in the following tabulation. The comments shown there give some of the reasoning behind the selection of particular growth rates.

**Annual Rates of Growth for Supply
Projections, 1975-80 (Percent)**

| | High | Medium | Low | Comment |
|---------------|------|--------|-----|--|
| Coal | 7 | 6.5 | 6 | <p>High: Coal output is projected to grow by 7% annually, 1975-80. This is below the highest rate shown above (7.7%, 1958-65) but is higher than the growth achieved since 1965. It compares to a 5.9% rate for 1958-74. With the sharp decline in growth that has occurred since 1970, 7% annual growth during 1975-80 should tax production capabilities in the coal industry.</p> <p>Medium: Coal output is projected to grow by 6.5% annually, faster than in 1966-74 (6.1%).</p> <p>Low: Projected at 6% annually.</p> |
| Oil | 20 | 15 | 10 | <p>High: Oil output is projected to grow by 20% annually. This is comparable to the rate of growth achieved in 1966-70 but is lower than the rates for the other periods, including that for the entire period 1958-74. However, even the 20% rate implies very heavy investment in the petroleum industry. Given the demands on investment resources implied by 7% growth in coal output, plus the normal fall in growth rates which can be expected as output rises, 20% growth must be considered high.</p> <p>Medium: Projected at 15% annually.</p> <p>Low: Projected at 10% annually.</p> |
| Natural gas | 20 | 15 | 10 | <p>High: Natural gas production is also projected to grow by 20% annually. After very rapid growth in 1958-65, natural gas production has grown at healthy, though declining, rates. The projected 20% rate is close to that for 1966-70; it reflects greater concern on the part of central authorities about energy waste. With the large investments required in pipelines, treatment facilities, and gas field equipment, production growth of 20% annually is high.</p> <p>Medium: Projected at 15% annually.</p> <p>Low: Projected at 10% annually.</p> |
| Hydroelectric | 10 | 8 | 6 | <p>High: Hydroelectric production is projected to grow at 10% annually, the 1958-74 average. Most of the growth will occur in small hydroelectric plants serving agriculture; but, following the rapid expansion of these rural facilities since the Cultural Revolution, growth will be more measured than the 14% annual growth of 1971-74.</p> <p>Medium: Projected at 8% annually.</p> <p>Low: Projected at 6% annually.</p> |

| Million Tons of Coal Equivalent | | | | | | |
|---------------------------------|------|-----|-----|--------------------|---------------------|---------------------|
| | Coal | Oil | Gas | Hydro- electric | Total Production | Supply ¹ |
| 1974 | 289 | 98 | 38 | 3 | 428 ² | 380 ² |
| 1980 | | | | | | |
| High | 434 | 293 | 113 | 5 | 845 | 777 |
| Medium | 422 | 226 | 88 | 5 | 741 | 682 |
| Low | 410 | 173 | 67 | 4 | 654 | 602 |

1. Supply in 1980 is calculated as 92% of total production. The difference between supply and total production consists of handling losses, additions to inventory, and a small amount of petroleum consumed by the military. It is assumed that lower handling losses and more efficient use of the energy inventory will increase the ratio of supply to total production from 90.7% in 1974 to 92% in 1980.

2. The apparent inconsistency between the explanation given in footnote 1 and the data for 1974 is explained by exports of 9 million tons of standard fuel equivalent in 1974.

Table 8

China: Production of Primary Energy

| | Coal (Million Metric Tons) | Crude Oil (Million Metric Tons) | Natural Gas (Billion Cubic Meters) | Hydroelectricity (Billion Kilo- watt Hours) |
|------|----------------------------------|---------------------------------------|--|---|
| 1952 | 66.5 | 0.44 | N.A. | 1.3 |
| 1957 | 130.7 | 1.46 | 0.6 | 4.7 |
| 1965 | 220.0 | 10.8 | 9.2 | 9.0 |
| 1970 | 310.0 | 28.5 | 20.7 | 14.0 |
| 1971 | 335.0 | 36.7 | 23.6 | 15.0 |
| 1972 | 356.0 | 43.0 | 27.0 | 20.0 |
| 1973 | 377.0 | 54.5 | 27.6 | 23.0 |
| 1974 | 389.0 | 65.3 | 28.8 | 24.0 |

APPENDIX D

PROJECTIONS OF ENERGY DEMAND IN 1980

The tabulation below, which shows average annual rates of growth of energy consumption by sector of consumption and time period, is presented for reference.

| Percent ¹ | | | | | |
|----------------------|----------|-------------|----------------|------------------------|-------|
| | Industry | Agriculture | Transportation | Residential/Commercial | Total |
| 1958-65 | 12 | 36 | 5.6 | 5.1 | 8.4 |
| 1966-70 | 12 | 15 | 3.2 | 3.7 | 8.5 |
| 1971-74 | 10.2 | 20 | 4.6 | 2.8 | 8.1 |
| 1958-74 | 12 | 26 | 4.7 | 4.2 | 9.4 |

1. Rates higher than 11% have been rounded.

Three projections were made: high, medium, and low. Under each, a growth rate for 1975-80 was selected for energy consumption in each sector, consumption in each sector was projected to 1980, and the individual projections were then summed to obtain total energy consumption (demand) in 1980.

As in the supply projections, for the high projection we have attempted to select growth rates which reflect a realistic maximal growth performance in 1975-80, keeping in mind the problems that have cropped up in the various sectors and also any evidence of Peking's plans.

In the 1975-80 period, Peking will continue to stress rapid growth in industry and agriculture (apparent in the above tabulation). However, some concessions must be made to the transportation sector, where bottlenecks have appeared in 1974 and 1975. The residential/commercial sector will continue in its state of neglect. The growth rates used in the projections are shown in the following tabulation. The comments shown there give the reader some of the reasoning behind the selection of particular growth rates.

**Annual Rates of Growth for Demand
Projections, 1975-80 (Percent)**

| | High | Medium | Low | Comment |
|------------------------|------|--------|-----|--|
| Industry | 13 | 11.5 | 10 | <p>High: Energy consumption in industry is projected to grow by 13% annually, roughly consistent with 10%-11% annual growth in industrial production. A 13% rate of growth exceeds the previous high rate shown in the above tabulation (12%).</p> <p>Medium: Projected at 11.5% annually, slightly above the rate for 1971-74.</p> <p>Low: Projected at 10% annually.</p> |
| Agriculture | 20 | 17.5 | 15 | <p>High: Energy consumption in agriculture is projected to grow by 20% annually. This is a continuation of the rate observed in 1971-74 and reflects Peking's determination to promote agricultural mechanization.</p> <p>Medium: Projected at 17.5% annually.</p> <p>Low: Projected at 15% annually.</p> |
| Transportation | 6 | 5 | 4 | <p>High: Energy consumption in transportation is projected to grow by 6% annually. This is above the 4.6% rate for 1971-74 and slightly above the 5.6% recorded in 1958-65. The transport problems that turned up in 1974 and 1975 make it clear that this sector will receive additional attention in 1975-80.</p> <p>Medium: Projected at 5% annually.</p> <p>Low: Projected at 4% annually.</p> |
| Residential/commercial | 5 | 4 | 3 | <p>High: Energy consumption in the residential/commercial sector is projected to grow by 5% annually. This compares to growth rates of 3.7% and 2.8% in 1966-70 and 1971-74 and is clearly a high rate. Although complaints about wages and incomes have been voiced, because of the demands of the other sectors little can be done for residential/commercial.</p> <p>Medium: Projected at 4% annually.</p> <p>Low: Projected at 3% annually.</p> |

| Million Tons of Coal Equivalent | | | | | |
|---------------------------------|----------|-------------|----------------|------------------------|---------------------|
| | Industry | Agriculture | Transportation | Residential/Commercial | Total Energy Demand |
| 1974 | 235 | 24 | 19 | 102 | 380 |
| 1980 | | | | | |
| High | 489 | 72 | 27 | 137 | 725 |
| Medium | 452 | 63 | 25 | 130 | 670 |
| Low | 416 | 55 | 24 | 121 | 616 |

Table 9

China: Consumption of Primary Energy, by Sector and Source¹

| Million Metric Tons of Coal Equivalent | | | | | |
|--|-------|-------|-------|-------|-------|
| | 1952 | 1957 | 1965 | 1970 | 1974 |
| Total consumption | 42.3 | 96.6 | 184.3 | 277.6 | 379.7 |
| Coal | 41.3 | 91.2 | 156.3 | 210.4 | 260.7 |
| Oil | 0.8 | 4.0 | 14.5 | 37.8 | 77.6 |
| Gas | .... | 0.8 | 12.3 | 27.6 | 38.4 |
| Hydroelectric | 0.2 | 0.6 | 1.1 | 1.8 | 3.0 |
| Industry and construction | 11.2 | 36.4 | 89.1 | 159.0 | 234.8 |
| Coal | 10.8 | 33.8 | 74.5 | 119.0 | 160.8 |
| Oil | 0.2 | 1.7 | 7.5 | 24.7 | 52.3 |
| Gas | .... | 0.4 | 6.2 | 13.8 | 19.2 |
| Hydroelectric | 0.1 | 0.5 | 0.9 | 1.5 | 2.5 |
| Agriculture | 0.1 | 0.5 | 5.8 | 11.6 | 24.0 |
| Coal | Negl. | Negl. | 1.2 | 2.1 | 4.0 |
| Oil | 0.1 | 0.5 | 4.5 | 9.3 | 19.6 |
| Gas | .... | .... | .... | .... | .... |
| Hydroelectric | Negl. | Negl. | 0.1 | 0.2 | 0.4 |
| Transportation | 5.3 | 8.9 | 13.8 | 16.2 | 19.4 |
| Coal | 5.0 | 7.8 | 12.1 | 13.5 | 14.9 |
| Oil | 0.2 | 1.1 | 1.7 | 2.7 | 4.5 |
| Gas | .... | .... | .... | .... | .... |
| Hydroelectric | Negl. | Negl. | Negl. | Negl. | Negl. |
| Residential/commercial | 25.7 | 50.8 | 75.6 | 90.8 | 101.5 |
| Coal | 25.4 | 49.6 | 68.5 | 75.8 | 81.0 |
| Oil | 0.3 | 0.7 | 0.8 | 1.1 | 1.2 |
| Gas | .... | 0.4 | 6.2 | 13.8 | 19.2 |
| Hydroelectric | Negl. | 0.1 | 0.1 | 0.1 | 0.1 |

1. Because of rounding, components may not add to the totals shown.